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AUTHOR	Dillner, Harry
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ABSTRACT

This autoinstructional lesson dealing with the study of population growth is the second part of a two-part sequence. This is a learning activity for high school students who have completed Part 1 of "Measuring Populations" and are capable of using a microscope and of preparing slides to be observed. The behavioral objectives, both general and specific, are listed in the teacher's guide. The necessary equipment and materials are listed. A script, a sample evaluation sheet, and a bibliography are part of the instructional packet. (EB)

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MEASURING POPULATIONS
PART II

Prepared by

Harry Dillner
Science Teacher
NEWARK SCHOOL DISTRICT

Printed and disseminated through the office of the Del Mod Component Coordinator for the State Department of Public Instruction, John G. Townsend Building, Dover, Delaware 19901

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A-T TEACHER'S GUIDE

Packet Number - AT 311
D
P. II

Subject - Populations

Title - "Measuring Populations - Part II"

Crade Level - High School

Prerequisites - Completion of "Measuring Populations - Part I"
Ability to use a microscope and prepare a slide.

Bheavioral Objectives - (attached)

Equipment and Material -

Tape Recorder
Tape - "Measuring Populations - Part II"
Compound Microscope
Slide
Glass stirring rod
Cover slip
Pipette (Medicine dropper)
Test tube with yeast cell culture (Prepare yeast cell culture just prior to use by adding several grains of dry yeast to about 20 ml of water.)
Test tube rack
Graduated cylinder (20 ml to 50 ml in size)
Drawing showing dimensions of field of view and coverslip (Figure 1 and 2)
Answer sheet
Chart of objectives

Script - (attached)

Sample Evaluation - (Use attached answer sheet)

Space Required - Carrel

Bibliography -

Biological Sciences Curriculum Study, Biological Science: An Inquiry Into Life, Harcourt, Brace, Inc. 1963, Chapter 40

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Cairns, John, Population Dynamics, Rand McNally 1966

A-T BEHAVIORAL OBJECTIVES

Measuring Populations - Part II

General

1. To measure the size of a yeast cell population.
2. To identify possible sources of error in measuring populations.
3. To devise and describe a technique for estimating the total number of bacteria on the human skin.

Specific

1. Given a test tube containing a yeast cell culture, a compound microscope, slide, cover slip, pipette, graduated cylinder, and dimensions of both the high power field of view and the coverslip, the student should be able to:

    A. accurately estimate the size of the yeast cell population using sampling technique
    B. identify possible sources of error in his procedure

2. To devise and describe a technique which could be utilized in measuring the total population of bacteria on the surface of the human skin.

A-T ANSWER SHEET

Measuring Populations - Part II

Name_____

Class_____

Place Answers Here	Perform Work Here
1._____Area of field of view 2._____Area of cover slip 3._____Number of fields of view that occupy the area of the cover slip 4._____Number of yeast cells in the 1st field of view 5._____Number of yeast cells in the 2nd field of view 6._____Number of yeast cells in the 3rd field of view 7._____Number of yeast cells in the 4th field of view 8._____Number of yeast cells in the 5th field of view 9._____Average number of yeast cells per field of view 10._____Number of yeast cells per drop 11._____Number of drops per milliliter 12._____Number of milliliters per test tube 13._____Number of yeast cells in the test tube	

Discussion Questions

1. Your answer is only an estimate of the total population size and may not reflect the true size of the population due to errors in your sampling technique. Suggest several ways in which errors could have been made.

2. Many bacteria live on the surface of the human skin. Devise and describe in detail a sampling technique appropriate for estimating the total population of bacteria found on the entire skin area of a human.

MEASURING POPULATIONS - PART II

Hello. If you have completed Part I of the lesson on Measuring Populations, you can recall that you measured the size of a lettuce seed population using sampling technique. Sampling is studying part of a population to gain information about the whole population. In sampling, you count the individuals in one or more parts of the population. From this data you then estimate the total number of individuals in the entire population.

In this investigation you will estimate the number of yeast cells in a yeast population. Locate the test tube containing the yeast cell culture. It is standing in a test tube rack in front of you. Estimating the size of this population is more difficult than estimating the size of the lettuce seed population because the yeast cells are microscopic and because they number in the millions.

Your first task is to select a portion of the yeast cell population for sampling. You will notice that most of the yeast cells have settled to the bottom of the test tube. To evenly distribute them, pick up the glass stirring rod and stir the yeast culture until the yeast cells are evenly distributed. Please turn the tape recorder off while you are doing this.

PAUSE

Now that the yeast cells are evenly distributed, a drop of the cells should be representative of the whole population. One drop represents a quantity of cells that is easier to study than the whole test tube of cells. Using the pipette or medicine dropper, place one drop of the culture on a microscope slide and cover it with a cover slip. Do <u>not</u> apply pressure to the cover slip. You will notice that the drop of culture spreads out evenly under the cover slip. Please turn the tape recorder off while you do this.

PAUSE

Place the prepared slide on the stage of the microscope and focus on low and then on high power. Turn the tape recorder off now.

PAUSE

With the high power lens in position you will notice that a large number of yeast cells occupies your field of view. You should also note that it is impossible for you to look at the entire drop of culture at any one time. Actually, your field of view comprises only a very small percentage of the total area of the coverslip. Since you cannot count every yeast cell in the drop, you must sample the cells in the drop. The area of your field of view represents a portion of the area of the cover slip. Figure 1, which is posted in front of you, shows a drawing of the

field of view on high power. The radius of the field of view is approximately 0.2 mm. Figure 2 is a drawing of the slide and cover slip. The cover slip measures 22mm on a side. Now calculate the area of the field of view and the area of the cover slip. The equations for calculating these areas are shown on Figures 1 and 2. Once these two areas are known, you can compute the number of fields of view that fit into the total area of the cover slip by dividing the area of the cover slip by the area of the field of view. Record these two areas and the number of fields of view per the area of the cover slip on the answer sheet provided for you. Please turn the tape recorder off while you make those calculations.

PAUSE

Now you will count the yeast cells that you see in your field of view. Since just one field of view may not be representative of the entire area under the cover slip, you should count the number of cells in 5 different fields of view and compute the average number per field of view. To randomly select which portion of the drop to sample, move the slide slightly while your eyes are closed. Wherever you stop the slide, make a count of the number of cells in the field of view. Remember, this procedure must be repeated 5 times. Record your 5 population counts on your answer sheet and compute the average number of cells per field of view. Turn the tape recorder off now.

PAUSE

You now have sufficient data to calculate the number of yeast cells per drop. Merely multiply the average number of cells per field of view times the number of fields of view which occupy the area of the cover slip. Record your answer on your answer sheet. Please turn the tape recorder off now.

PAUSE

Next, it is necessary to determine the number of drops of yeast cell culture in the test tube. Counting the drops one by one would take an excessive amount of time, therefore, you will determine the number of drops that make up one milliliter and then the number of milliliters in the test tube. With the pipette, add drops of yeast culture one by one to the graduated cylinder counting the number of drops it takes to make exactly 1 milliliter. Next, pour the entire contents of the test tube into the graduated cylinder to determine the total number of milliliters in the test tube. Record both answers on your answer sheet. Please turn the tape recorder off.

PAUSE

By multiplying the number of drops of yeast culture in the tube times the number of yeast cells per drop, you will determine the estimated number of cells in the test tube. Turn the tape recorder off while you make this calculation and record your answer.

PAUSE

You have now completed the procedure for estimating the total yeast cell population. It is a rather complicated procedure, but it is typical of sampling techniques used in measuring dense populations of micro organisms whether they be yeast cells, bacteria algae, or protozoans. At the end of your answer sheet you will notice two discussion questions. These questions are designed to measure your understanding of sampling techniques. The first discussion question asks you to suggest several ways in which you could have made errors in arriving at an estimate of the yeast cell population. The second discussion question requires a more detailed answer. Here you are asked to apply your knowledge of sampling to a different population. The question asks you to suggest a sampling technique for estimating the total number of bacteria that are found on the total surface of the skin of a human. Please give these two questions some careful thought and answer them to the best of your ability. You may wish to clean your slide and cover slip and return all materials to their original position before answering the discussion questions. Give your answer sheet to your teacher as you leave the room. Your teacher will tell you if your population estimate is reasonably accurate.